General Instrument Maintenance Protocol

1 Scope

The purpose of this document is to provide definitions and general guidelines for the interpretation of the specific performance monitoring protocol available for each type of instrument. This document applies to personnel using the associated instrument(s)/equipment in the following discipline/category of testing: Explosives (chemistry) examinations performed at the Huntsville facility.

2 Principle

Instruments available for the analysis of evidence are purchased from a variety of different manufacturers. All instruments eventually require maintenance, troubleshooting, and repair. Although the user interface and hardware fittings may differ, the overall instrument principles and maintenance are consistent.

This protocol divides instrument maintenance into two categories: preventative and corrective. Preventative maintenance involves routine monitoring of performance, adjustment of common parameters (i.e. head pressure, solvent degas), and replacement of consumable items (i.e. septa, columns) in order to ensure reproducible and uninterrupted operation. Corrective maintenance may be required when poor performance is observed or the instrument fails to operate properly.

All performance monitoring protocols are based upon manufacturer's recommendations. Users are encouraged to refer to the manufacturer's instrument manuals for more information on maintenance and troubleshooting. Users will be familiar with the operation of the instrument as described in the manual(s), specific instrument performance monitoring protocols, appropriate discipline SOPs, and receive training from instrument support personnel, a trained operator, and/or the instrument manufacturer before operating such equipment.

The maintenance and operating procedures are categorized by how often they will be performed (daily, monthly, yearly, and/or as needed: defined below) to insure the integrity of the system. These terms are approximate time intervals, based on instrument use, and allow for weekends and other periods of instrument inactivity. If other intervals will be followed, they will be specified in the applicable SOP.

3 Equipment/Materials/Reagents

Any materials (such as pump oil and solvents) and all replacement parts will meet manufacturer's specifications and recommendations. Manufacturer's instrument manuals and specific performance monitoring protocols are generally the best source for this information.

Note that performance monitoring protocols refer to the manufacturer's name at the time of installation. Refer to the appropriate instrument support personnel for updated contact information for instrument parts, documentation, and service.

4 Standards and Controls

All standards, solutions, and mobile phases required are specified in the appropriate SOP.

5 Calibration

Any procedures used to calibrate and/or verify the integrity of the instrument will be specified in the appropriate SOP. Instruments that are calibrated by an outside vendor, such as pipettes, are tracked in the Forensic Advantage (FA) Resource Manager (RM).

6 Sampling or Sample Selection

Not applicable.

7 Abbreviations and Definitions

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Accurate Mass	Refers to the mass accuracy of a high-resolution mass spectrometer such as an OrbiTrap
As Needed	Refers to maintenance that is to be performed based on system performance or major interruptions in service
ATR	Attenuated Total Reflectance (FTIR Accessory, Objective)
Calibration	Correcting instrument responses to a known value (e.g. mass correction performed on an OrbiTrap mass spectrometer)
Centroid	Centered, non-continuous mass spectrometer data
Chromatogram	The detector response chart generated by a chromatographic instrument, generally plotted as response versus time
CI	Chemical Impact (ionization)
Daily	Refers to each day the instrument is used for analysis

Redacted

EI	Electron Impact (ionization)
EU	Explosives Unit
FTIR	Fourier Transform Infrared (Spectrophotometer, Spectrophotometry)
GC	Gas Chromatograph(y) - Refer to the "Gas Chromatograph General Maintenance Protocol" for GC-specific maintenance, and troubleshooting

Redacted

HPLC	High Performance Liquid Chromatography (used synonymously with LC below)
IOG	Instrument Operations Group
LC	Liquid Chromatograph(y) - Refer to the "Liquid Chromatograph General Maintenance Protocol" for LC-specific maintenance, and troubleshooting
m/z	Mass-to-Charge Ratio
Manufacturer's Instrument Manual(s)	Paper or electronic instrument documentation provided by the manufacturer
MCP	Micro Channel Plate
Monthly	Refers to each calendar month, not to exceed 45 calendar days from the previous month's date of maintenance
MS	Mass Spectrometer (Spectrometry) - Refer to the "Mass Spectrometer General Maintenance Protocol" for MS-specific abbreviations, theory, maintenance, and troubleshooting

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NIST	National Institute of Standards and Technology
Operator	Personnel trained to use the instrumentation
Peak	A detector response that rises above the observed baseline. A response is considered a peak if it has a minimum SNR of 3:1

Performance Standard/Testmix	A standard, known chemical or mixture of chemicals, used to test the performance of an instrument

Redacted

PFTBA	Perfluorotributylamine
PMP	Performance Monitoring Protocol. Interchangeably used in place of Standard Operating Procedure
Profile/Continuum	Mass spectrometer data collected continuously without centroiding
QA/QC	Quality Assurance/Quality Control

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RIC	Reconstructed Ion Chromatogram
RMS	Root Mean Square
RSD	Relative Standard Deviation
SAU	Scientific Analysis Unit
SNR	Signal to Noise Ratio (SNR). A comparison of the electronic response of an analyte to the baseline noise
SOP	Standard Operating Procedure. Interchangeably used in place of Performance Monitoring Protocol

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TIC	Total Ion Chromatogram

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Tuning	Adjusting parameters (e.g. lens voltages) to maximize instrument performance
Unit - Mass	Refers to the mass resolution of a standard quadrupole or ion trap mass spectrometer
UPLC	Ultra-Performance Liquid Chromatography
Yearly	Refers to annual maintenance

8 Procedures

8.1 Performance Monitoring

The purpose of the performance monitoring protocols is to verify and track reproducibility, quality, accuracy, and reliability of instrument operation and generated data from analysis to analysis, day to day, and year to year. This includes documenting specific instrument parameters and performing and documenting specific tasks. This information is then available to track instrument performance patterns or to be used in court. These tasks are outlined under the 'Procedures' section of the performance monitoring protocols.

8.2 Preventative Maintenance

In order to prevent instrument downtime and casework delays, certain maintenance tasks will be required to be performed on a routine, predetermined schedule - daily, monthly, or yearly. These tasks will usually involve replacing parts before they cause problems. They are outlined under the 'Procedures' section of the performance monitoring protocols.

Each type and model of an instrument may have different, specialized components requiring specific preventative maintenance. Suggested step-by-step directions for specific maintenance procedures may be found in the manufacturer's instrument manuals. When performed, all preventative maintenance will be entered into the appropriate log.

8.3 Corrective Maintenance

Evidence of poor performance or instrument malfunction should indicate to the operator to take corrective measures. There are some things the operator may try before contacting appropriate instrument support personnel to resolve the issue, depending on their level of training and comfort. Tips on general troubleshooting are provided by appropriate instrument support personnel. In addition, the operator may consult the manufacturer's instrument manual. If the operator is still unable to correct the problem, they may contact appropriate instrument support personnel by submitting a request for repair. All corrective maintenance will be entered into the appropriate log.

8.3.1 Poor Performance

The necessity for maintenance will occur when the instrument fails to meet protocol decision criteria specifications or if other poor performance, such as a loss of sensitivity, is observed. Follow the above protocol in 8.3.

8.3.2 Instrument Malfunction

In the event of an instrument malfunction such as hardware or software failure that cannot be resolved by the above protocol in 8.3, and appropriate instrument support personnel are unable to resolve the issue, they will contact the instrument manufacturer's service representative.

8.4 Documentation

Any instrument log sheets and logbooks referred to in the 'Procedures' section of each SOP can be either paper or electronic format. Any example QA/QC logs and printouts are for reference only and may differ in appearance and form from the actual documents generated.

a. All instruments that have a series of performance checks (such as daily or monthly) will have a QA/QC log. The operator will enter the appropriate information required by the SOP 'Procedures' section.

b. Upon completion and passing of all checks, the operator will print the necessary reports and initial. If more than one page is generated, all pages must be initialed. The date should also appear somewhere on the initialed page(s). The printout(s) will be placed in the three-ring QA/QC binder in the appropriate section(s).

c. The operator will record sample types, problems, pass/fail, maintenance, and comments in the appropriate log, as appropriate.

9 Instrumental Conditions

Any parameters required to monitor the performance of an instrument will be specified in the appropriate SOP.

9.1 Minor Modifications

Some of the instrumental conditions referenced in the 'Instrument Conditions' section of an SOP may be slightly modified to obtain optimum instrument performance on a specific instrument. Any minor modifications to a performance monitoring protocol will require the approval of the appropriate instrument support personnel who will determine if the change is appropriate for the instrument. The modification and its approval will be recorded in the appropriate log.

10 Decision Criteria

Every performance monitoring protocol will have specific decision criteria to determine if the instrument is operating properly. If these should fail, refer to the 'Corrective Maintenance' section of this protocol in conjunction with the instrument-specific SOP.

11 Calculations

Not applicable.

12 Uncertainty of Measurement

Not applicable.

13 Limitations

Only properly trained personnel will perform duties involved in the operation, maintenance, or troubleshooting of this instrument. Instrument-specific limitations will be specified in the appropriate SOP.

14 Safety

Take standard precautions for the handling of all chemicals, reagents, and standards. Refer to the *FBI Laboratory Safety Manual* for the proper handling and disposal of all chemicals. Personal protective equipment should be used when handling any chemical and when performing any type of analysis. Many instrument components are held at temperatures of 250°C and higher. Precautions should be taken to prevent the contact of skin with heated surfaces and areas.

15 References

Instrument Operations Group SOP Manual.

Manufacturer's Instrument Manuals for the specific models and accessories used.

"Gas Chromatograph General Maintenance Protocol" (IOG 002) *Instrument Operations Group SOP Manual.*

"Liquid Chromatograph General Maintenance Protocol" (IOG 003) *Instrument Operations Group SOP Manual.*

"Mass Spectrometer General Maintenance Protocol" (IOG 004) *Instrument Operations Group SOP Manual.*

FBI Laboratory Safety Manual.

FBI Laboratory Quality Assurance Manual.

FBI Laboratory Operations Manual.

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0	10/04/18	New document that specifies instrument protocol for the Huntsville facility.

Approval

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